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Anatomical Study of Anterior Interosseous Nerve in Indian Adult Cadavers.

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ABSTRACT

The anterior interosseous nerve is the largest motor branch of median nerve. It supplies forearm muscles like flexor pollicis longus, lateral part of flexor digitorum profundus and pronator quadratus muscle. The anterior interosseous nerve and its branches are vulnerable to injury in open reduction of the fracture of the mid shaft of the radius, in muscle slide procedure and in supracondylar fractures of Humerus. We aimed to study the level of origin of anterior interosseous nerve with respect to interepicondylar line and its number of muscular branches to flexor digitorum profundus and flexor pollicis longus muscles. The study was done by dissection method on 50 upper limb specimens. The point of origin of Anterior interosseous nerve ranged between 1.8 to 6cm and its mean point of origin was 3.39cm distal to interepicondylar line. It innervated flexor pollicis longus muscle by 1-2 branches and flexor digitorum profundus by 1-3 branches. Anatomical knowledge of anterior interosseous nerve and its muscular branches are of immense importance for surgeons, orthopedicians and physiotherapists in diagnosis, treatment of lesions of forearm and to avoid complications during surgery.

Keywords: Anterior interosseous nerve, Median nerve, Interepicondylar line, Flexor pollicis longus, Flexor digitorum profundus.

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INTRODUCTION

The AIN (AIN) is the largest motor branch of median nerve (MN). It branches from the MN between the two heads of pronator teres, just distal to the origin of muscular branches of MN to the superficial flexor muscles of forearm and proximal to the point at which the MN passes under the tendinous arch of flexor digitorum superficialis. AIN runs distally along with the anterior interosseous artery between flexor digitorum profundus (FDP) and flexor pollicis longus (FPL) muscles. It travels deep to pronator quadratus and supplies articular branches to the distal radio-ulnar, radio carpal and carpal joints. AIN supplies FPL, lateral part of FDP (which sends tendons to the index and middle finger) and pronator quadratus (PQ) muscle and distal radio ulnar, radio carpal, and intercarpal joints [1].

Injury to AIN causes approximately 1% of all upper extremity peripheral nerve palsies [2]. AIN and its branches are vulnerable to injury in open reduction of the fracture of the mid shaft of the radius and in muscle slide procedure [3]. It is prone for injury following misplaced injection, anomalous bands or muscles of forearm, surgical procedures like exposure of the veins accompanying brachial artery in the cubital fossa for cardiac catheterisation, and open reduction of forearm fractures [4-8]. The supracondylar fractures have been associated with 5-19% incidence of AIN injury [9]. Detailed anatomical knowledge of innervation pattern of the forearm muscles are of clinical significance for surgical reconstruction in complex injuries, in treatment of paralytic conditions and muscular spasticity of the forearm in post-stroke patients through selective neurolysis [10].

The anatomical study of AIN is helpful for physiotherapists in the follow up and rehabilitation of the paralyzed patients and patients with muscular spasticity. Anatomical knowledge of AIN and its muscular branches are of helpful for surgeons, orthopedicians and physiotherapists in diagnosis and treatment of lesions of forearm [11].

The AIN may be affected along with MN or by itself in any of the causes of pronator syndrome. AIN syndrome presents classically as an inability to flex the interphalangeal joint of thumb and distal interphalangeal joint of index finger. The most common aetiology of this syndrome is compression by fibrous bands at the deep head of pronator teres muscle or at the tendinous origin of flexor digitorum superficialis. Other causes include trauma, neuralgic amyotrophy, thrombosis of anterior interosseous artery, direct pressure on volar aspect of forearm, and metastatic bronchogenic carcinoma [12].

Aims and Objectives

- To study the level of origin of AIN with respect to interepicondylar line (IEL).
- To study the number of muscular branches of AIN to the muscles of forearm, FPL and FDP.

MATERIALS AND METHODS

The present study was done by dissection method on 50 upperlimbs (24right and 26left) of embalmed cadavers of Indian origin. On the flexor aspect of upper limb, a

transverse incision was made 4cm proximal to a line joining medial and lateral epicondyles of humerus (Interepicondylar line). Another transverse incision was taken at proximal crease of the wrist just proximal to flexor retinaculum. A midline longitudinal incision was made joining these two transverse incisions.

After reflecting the skin and fasciae, bicipital aponeurosis was cut near the biceps brachii muscle. The superficial flexor muscles of forearm and median nerve were identified. The humeral head of pronator teres muscle was cut near its insertion. The tendons of flexor carpi radialis, palmaris longus and flexor digitorum superficialis were cut in the distal part of forearm, proximal to flexor retinaculum. The radial part of the flexor digitorum superficialis muscle was detached near its origin from the radius. The AIN was identified and traced between FDP and FPL muscles. The level of origin of AIN with respect to IEL and the number of its muscular branches to FDP and FPL were noted.

RESULTS

Level of origin of AIN

In 24 right upperlimbs the point of origin of AIN ranged between 1.8 to 5cm distal to IEL. Its mean point of origin was 3.47 ± 0.9 cm distal to IEL.

In 26 left upperlimbs the point of origin of AIN ranged between 1.8 to 6cm distal to IEL. Its mean point of origin was 3.31 ± 1.11 cm distal to IEL.

Out of total of 50 cases, AIN was arising at a mean distance of 3.39 ± 1.01 cm (range 1.8 to 6 cm) distal to the interepicondylar line. (Table-1)

Muscular branch of AIN to FPL

In the right upper limbs, FPL was innervated from the AIN by a single branch in 21 specimens (87.5%) and 2 branches in 3 specimens (12.5%) where as in the left upper limbs it was by single branch in 20 specimens (76.9%) and 2 branches in 6 specimens (23.1%). Among total of 50 specimens, 41 specimens (82%) were innervated by single branch and 9 specimens (18%) were innervated by 2 branches (Table No.2)

Muscular branch of AIN to FDP

In the right upper limbs, the number of branches from AIN to FDP was single in 17 specimens (70.8%), 2 in 6 specimens (25%), and 3 in 1 specimen (4.2%) where as in left upper limbs, it was single in 23 specimens (88.5%), 2 in 2 specimens (7.7%) and 3 in one specimen (3.8%). Out of 50 specimens, 40 specimens (80%) were innervated by single branch, 8 specimens (16%) by 2 branches and 2 specimens (4%) by 3 branches from the AIN. (Table No.2)

In one specimen nerve to FDP was arising directly from the trunk of median nerve.

Table No.1.

Level of origin	Right (n=24)	Left (n=26)	Total (n=50)
Range (cm)	1.8-5	1.8-6	1.8-6
Mean (cm)	3.47	3.31	3.39
Standard deviation (cm)	0.9	1.11	1.01

n-Number of specimens.

Table No.2

Muscular branch	Number of branches	Right (n=24) No. (%)	Left (n=26) No. (%)	Total (n=50) No. (%)
NFPL	1	21 (87.5%)	20 (76.9%)	41 (82%)
	2	3 (12.5%)	6 (23.1%)	9 (18%)
NFDP	1	17 (70.8%)	23 (88.5%)	40 (80%)
	2	6 (25%)	2 (7.7%)	8 (16%)
	3	1 (4.2%)	1 (3.8%)	2 (40%)

n-Number of specimens, NFPL-nerve to Flexor pollicis longus, NFDP-nerve to Flexor digitorum profundus.

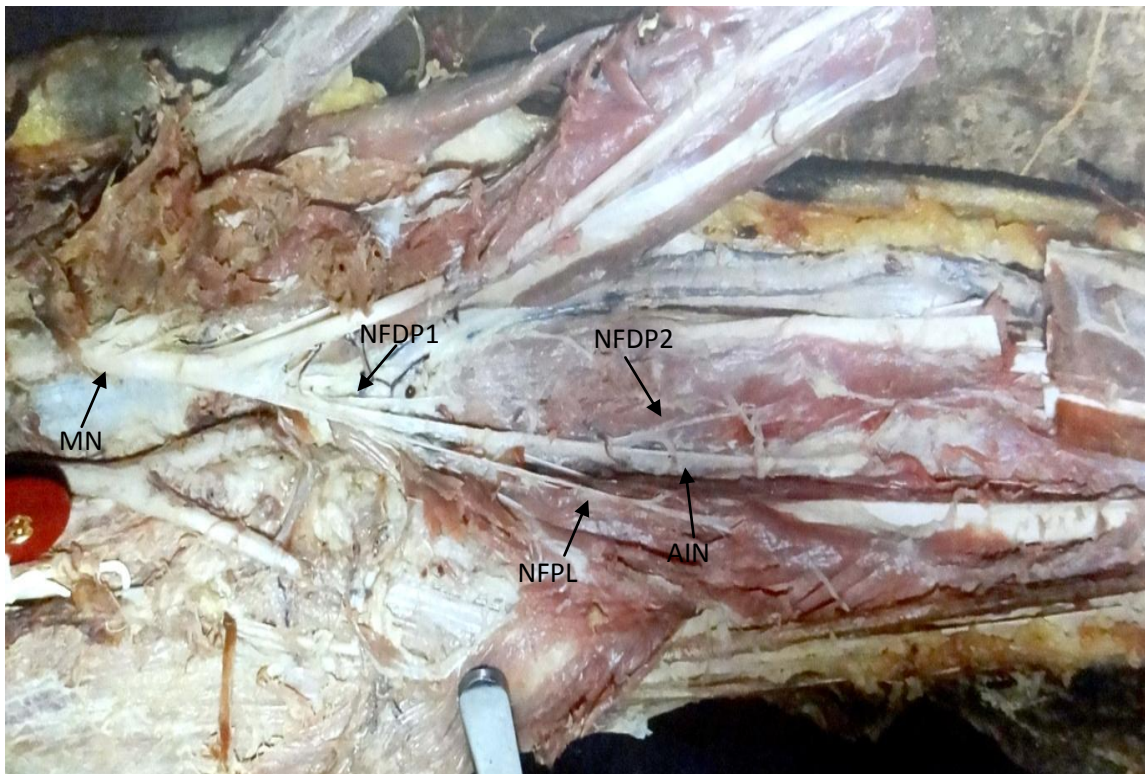


Fig. 1 showing AIN arising from MN distal to IEL and giving 2 branches to FDP and 1 branch to FPL.

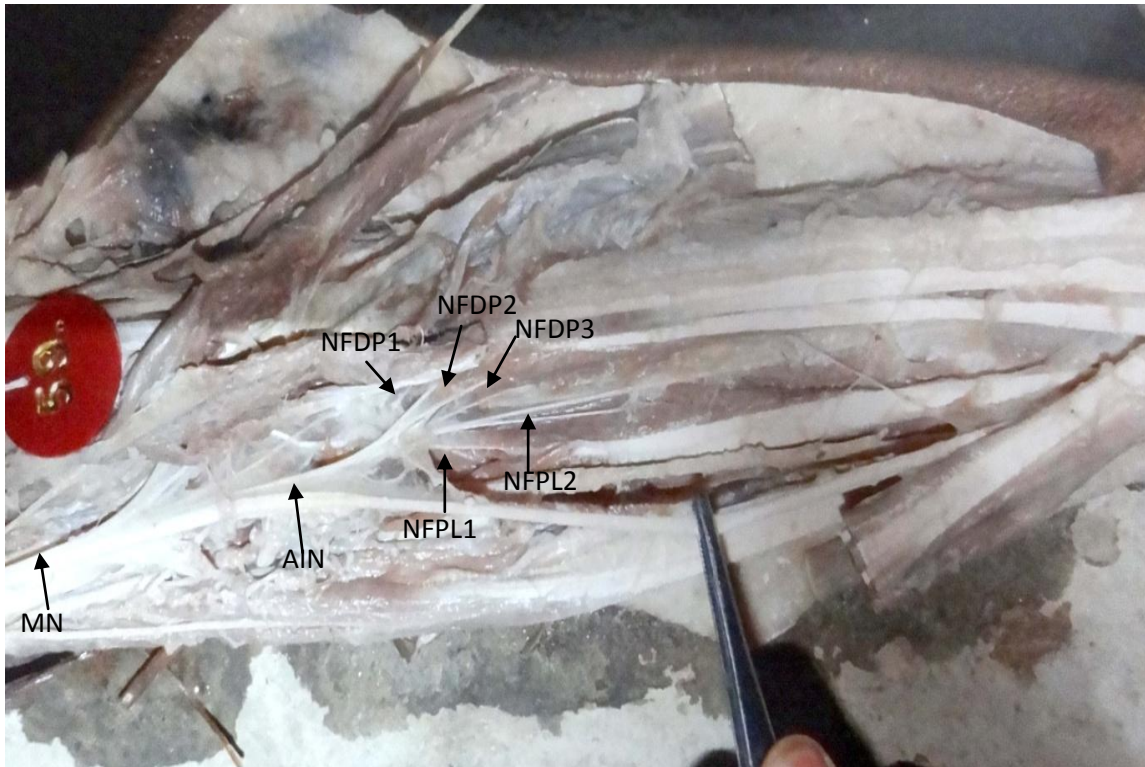


Fig. 2 showing AIN arising from MN distal to IEL and giving 3 branches to FDP and 2 branches to FPL.

DISCUSSION

There are very few anatomical studies of innervation of AIN in the literature[11].

The muscular branches of AIN is of useful in neurotisation procedures of posterior interosseous nerve and ulnar nerve.

Anterior interosseous nerve arises 5 to 8 cm distal to the level of the lateral epicondyle, usually immediately distal to the superficial head of pronator teres [3].

In a study made by Canovas et al, the point of origin of AIN was between 2.5cm and 6.5cm below the epicondyles. Its mean point of origin was 4.3cm below the epicondyles [13]. The present study coincides with study made by Canovas.

Anterior interosseous nerve originated from the median nerve within 3.5 cm proximal to the articular line of the elbow in 40% of specimens, at the same level of the line in 30% of specimens and within 5 cm distal to the articular line in 35% of specimens [11].

Alves et al. reported that the AIN originates from the median nerve in the distal third of the arm proximal to the articular line of the elbow [14].

According to Tubbs et al. the AIN originates from the median nerve distal to the medial or lateral epicondyles [15].

In our study AIN was arising from the median nerve distal to IELin all the specimens. The point of origin of AIN was ranged between 1.8 to 5cm and 1.8 to 6cm distal to IELin right and left upperlimbs respectively.

In the present study the FPL muscle was supplied by single branch from AIN in 41 specimens (82%) and by 2 branches in 9 specimens (18%) where as in study made by Canovas, it was innervated by 1-4 small branches from AIN.

Essa TM observed single branch to the FPL muscle in 35% of specimens two branches in 50% of specimens, three branches in 10% of specimens and four branches in 5% of specimens FDP received two branches in 35% of the specimens ,3 branches in 40% of specimens and 4 branches in 25% of specimens [11].

In the present study FDP received single branch in 40 specimens (80%), two branches in 8 specimens (16%) and three branches in 2 specimens (4%). This correlates with study of Canovas, who observed 1-4 branches from AIN innervating the FDP muscle. However it is lower than observations made by Sunderland who reported 2-6 branches in 17 out of 20 cases.

In the present study of 50 specimens the FDP muscle was innervated by a branch directly from the trunk of median nerve in one specimen (1%) which was the only nerve supply to that muscle. Sunderland has reported supplementary branches directly from median nerve innervating the FDP muscle in 10% of the specimens [13].

CONCLUSION

In all the specimens the anterior interosseous nerve was arising distal to the interepicondylar line. AIN innervated FPL by 1-2 branches and FDP by 1-3 branches. In all the specimens AIN passed deep to pronator quadratus muscle to innervate it. Anatomical knowledge of anterior interosseous nerve (AIN) and its muscular branches are of immense importance for surgeons, orthopedicians and physiotherapists in diagnosis, treatment of lesions of forearm and to avoid complications during surgery.

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